Technical Support Package

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'Flexible Seal Accommodates Part Mismatch'

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For

FLEXIBLE SEAL ACCOMMODATES PART MISMATCH

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FLEXIBLE SEAL ACCOMMODATES PART MISMATCH

A radial seal was needed on the inside diameter of a part that develops an out-of-round condition and grows under pressure. Since a radial seal that would accommodate part growth and change from concentric to an out-of-round condition under pressure was nowhere available, a new seal was developed. Figure 1 graphically illustrates the change of the part from cylindrical to elliptical shape. The change of shape, as shown in Figure 1, actually occurs inside of the main combustion chamber (MCC) during internal pressure testing for structural integrity of welds. The pressure required to test manifolds welds is in excess of the pressure that is safe for internal passages. Internal passages are closed inside of MCC by electrodeposited material and would delaminate under the pressure required for testing of manifolds. To prevent delamination of the electrodeposited liner, the liner has to be supported on the inside of the MCC. Support of the liner from the inside by mechanical means was found unacceptable. The only way to provide equal support throughout the affected area is by pressurization.

The primary seal consists of overlapping segments (Figure 2) fabricated from metal or composite material that has been molded into a rubber jacket. The purpose of the segments is to provide the strength to withstand side loads (seal tested at 2,300 psi), and the rubber encapsulation (Figure 3) provides the sealing surface and needed flexibility to conform to the variable eccentric shape.

Since the primary seal must be forced to follow the constantly changing contour of the part while being pressurized, a slightly

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higher pressure must be applied to the inside diameter of the seal to offset the side load. This is accomplished by the application of a drivar seal. The driver seal is a double spring-loaded pressure-actuated configuration. At high pressures, between the primary and driver seals, two split metal backup rings may be inserted to prevent flow of the driver seal heel into the rubber jacket of the primary seal.

The schematic in Figure 4 shows an application of the seal, and Figure 5 shows the actual pressure test fixture and the seal as used for testing the MCC. This seal set design has been performance tested and proven on development and production hardware, namely, the Space Shuttle main combustion chamber (see Fig. 5).

New and significant features of this seal are: (1) Ability to seal a gap between a pressure test fixture and the part up to 1/2 inch, perhaps larger, depending on the pressure. Until now using commercially available seals, the gap, depending on pressure, varied between 0.0005 to 0.010 inches. (2) Ability of the seal to accommodate the growth of the part under pressure and follow the change of out-of-round conditions of the part under test. Previously no available seal would provide such capability.

Potential applications for the seal are numerous:

(1) Pressure testing any cylindrical body with variable wall thickness, where the growth will be uneven.

(2) Seal a multicavity part with differential pressures, causing the change of the part from cylindrical to out-of-round (see Figure 6).

(3) Pressure testing seam welded pipes, tubes, and pressure vessels (All cylindrical bodies, fabricated from rolled plate by seam welding under pressure, have a tendency to reduce the radius at the weld and enlarge the radius 90° from the weld).

(4) Seal a multicavity part with variable pressures (see Figure 6).

(5) Seal on a tapered surface while the shape of the sealing surface continuously changes until specified pressure is attained (see Figure 6).

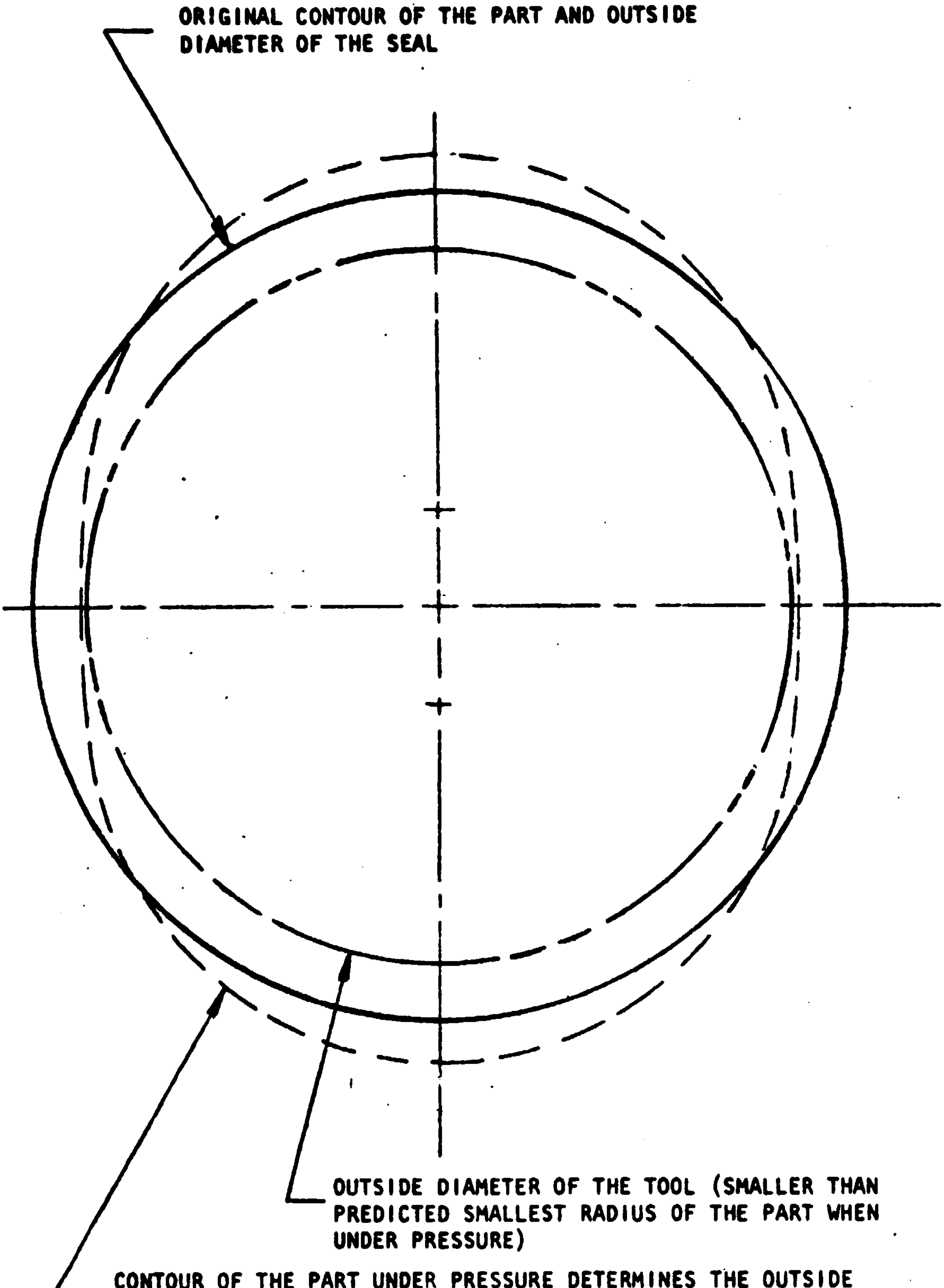
ORIGINAL CONTOUR OF THE PART AND OUTSIDE DIAMETER OF THE SEAL
OUTSIDE DIAMETER OF THE TOOL (SMALLER THAN PREDICTED SMALLEST RADIUS OF THE PART WHEN UNDER PRESSURE)
CONTOUR OF THE PART UNDER PRESSURE DETERMINES THE OUTSIDE DIAMETER OF THE TOOL

FIG. 1

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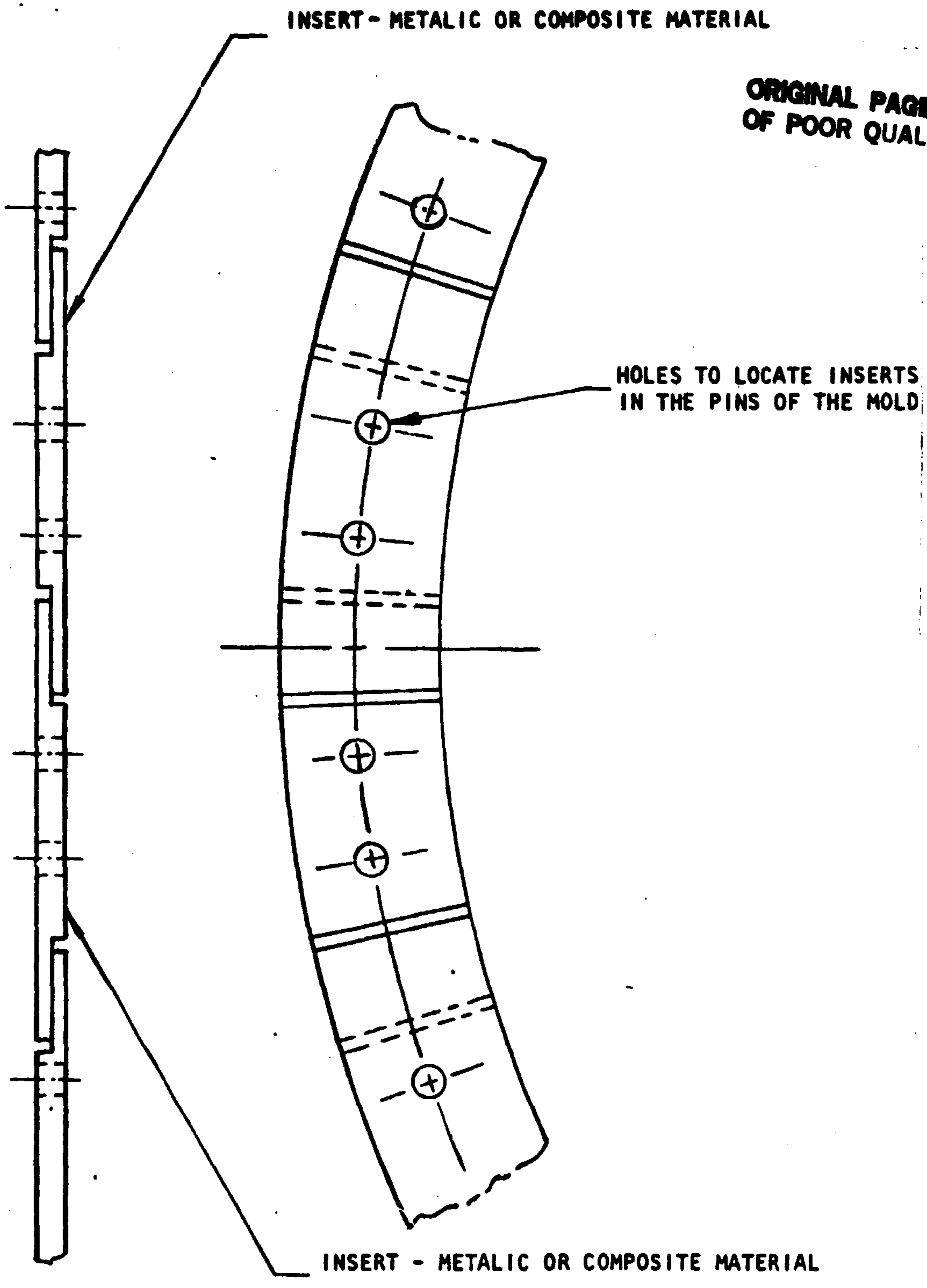

FIG. 2

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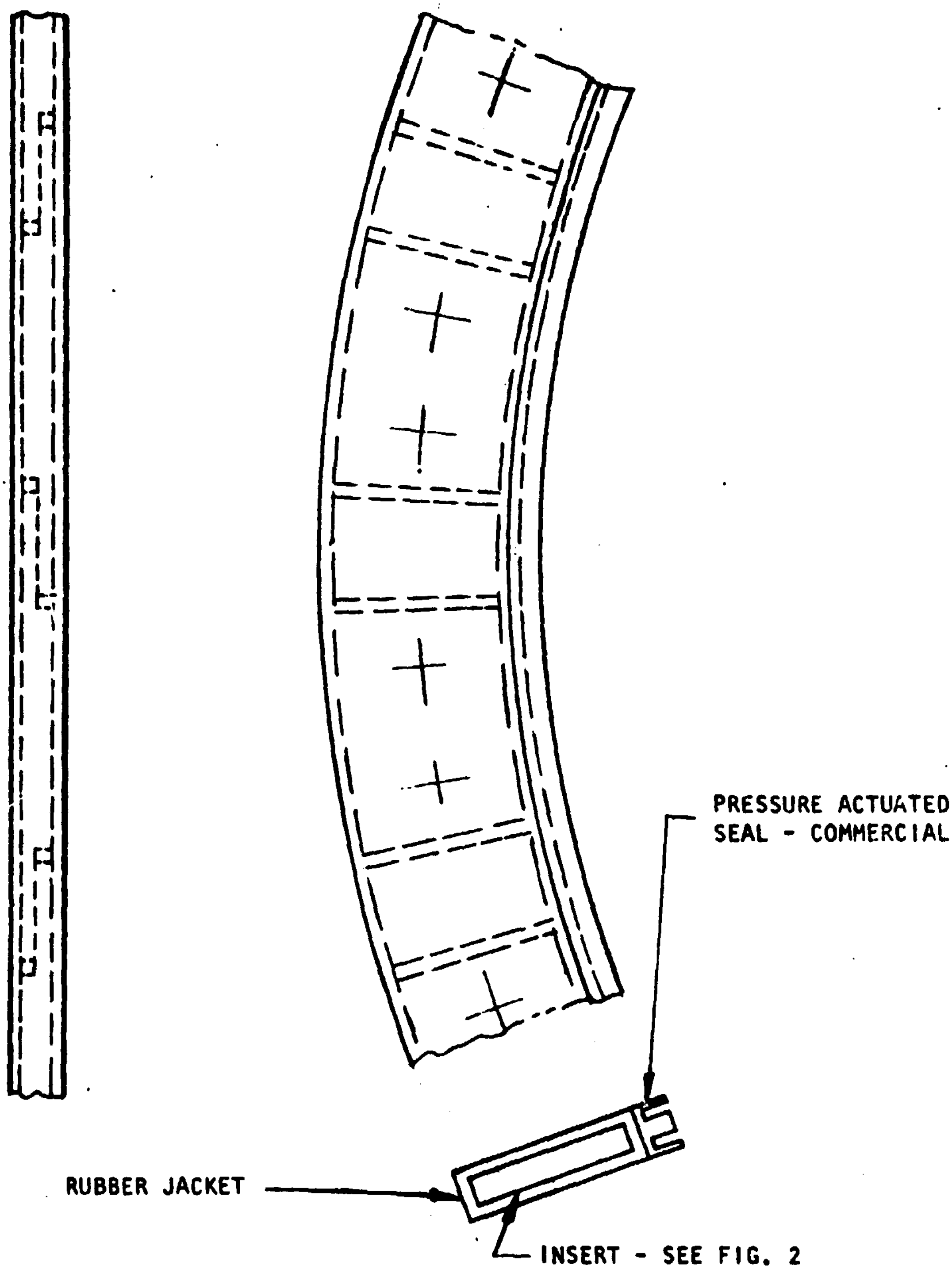

FIG. 3

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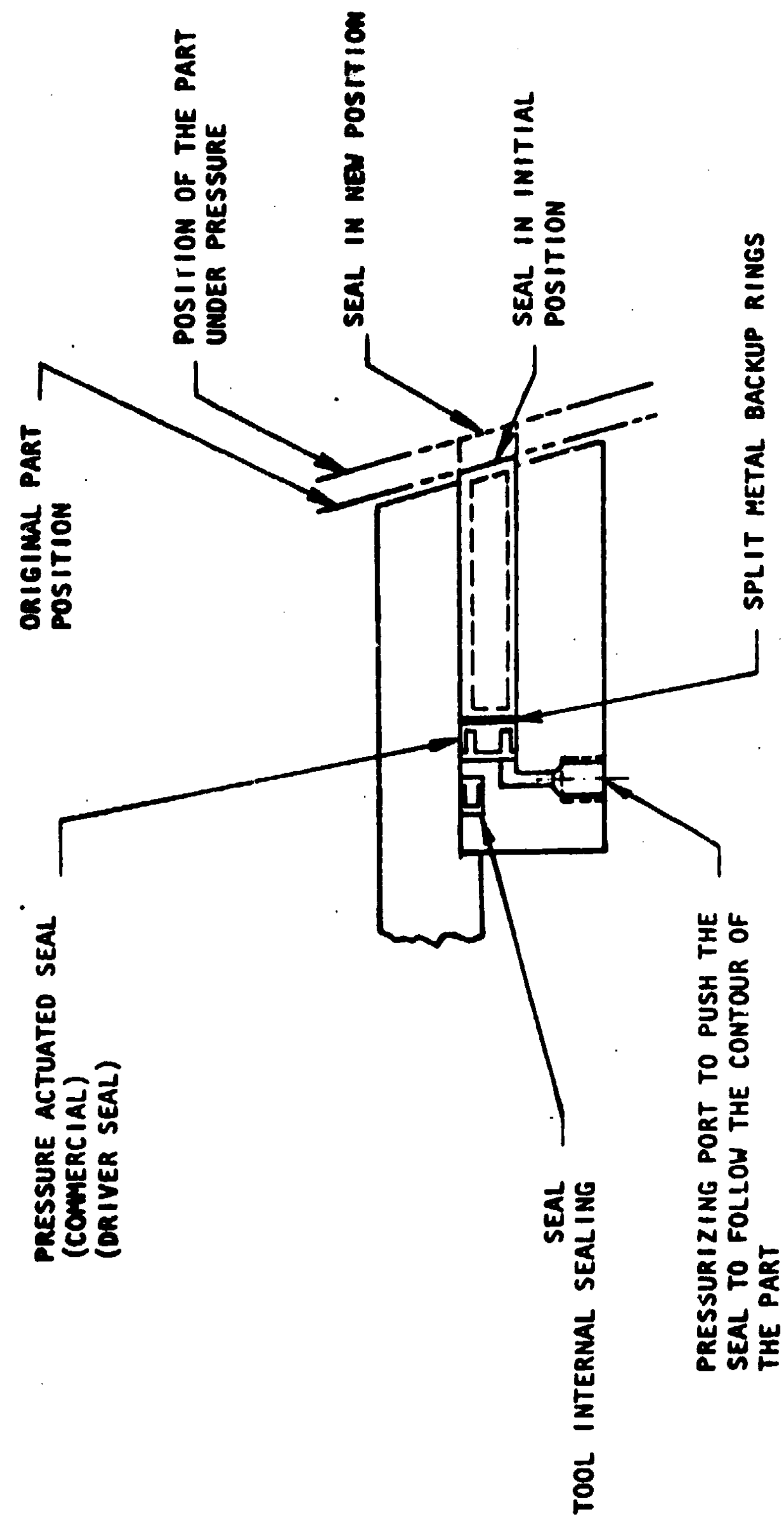

FIG. 4

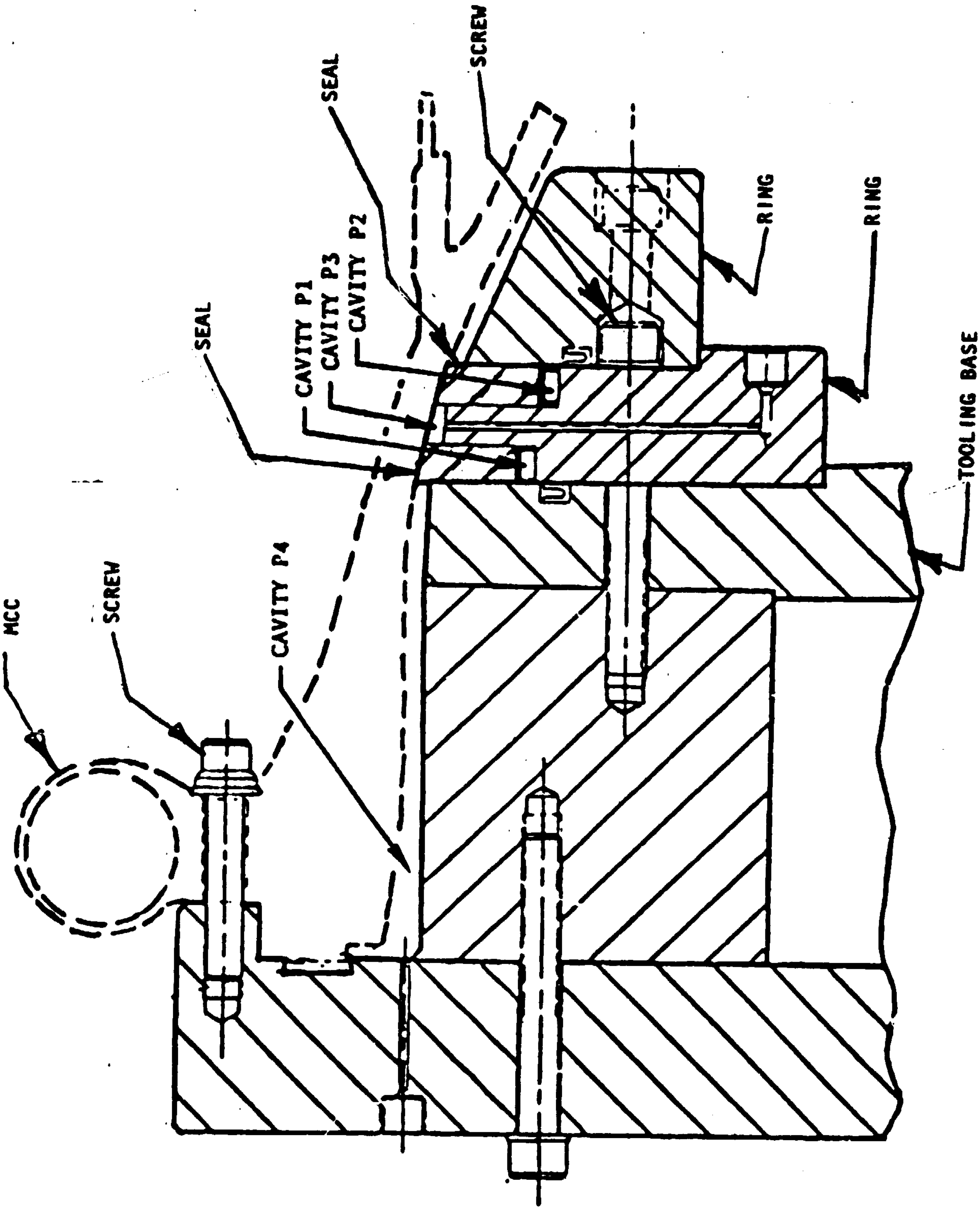
SCREW
SEAL
CAVITY P1
CAVITY P3
CAVITY P2
SEAL
RING
RING
TOOLING BASE
MCC
SCREW
CAVITY P4

FIG. 5

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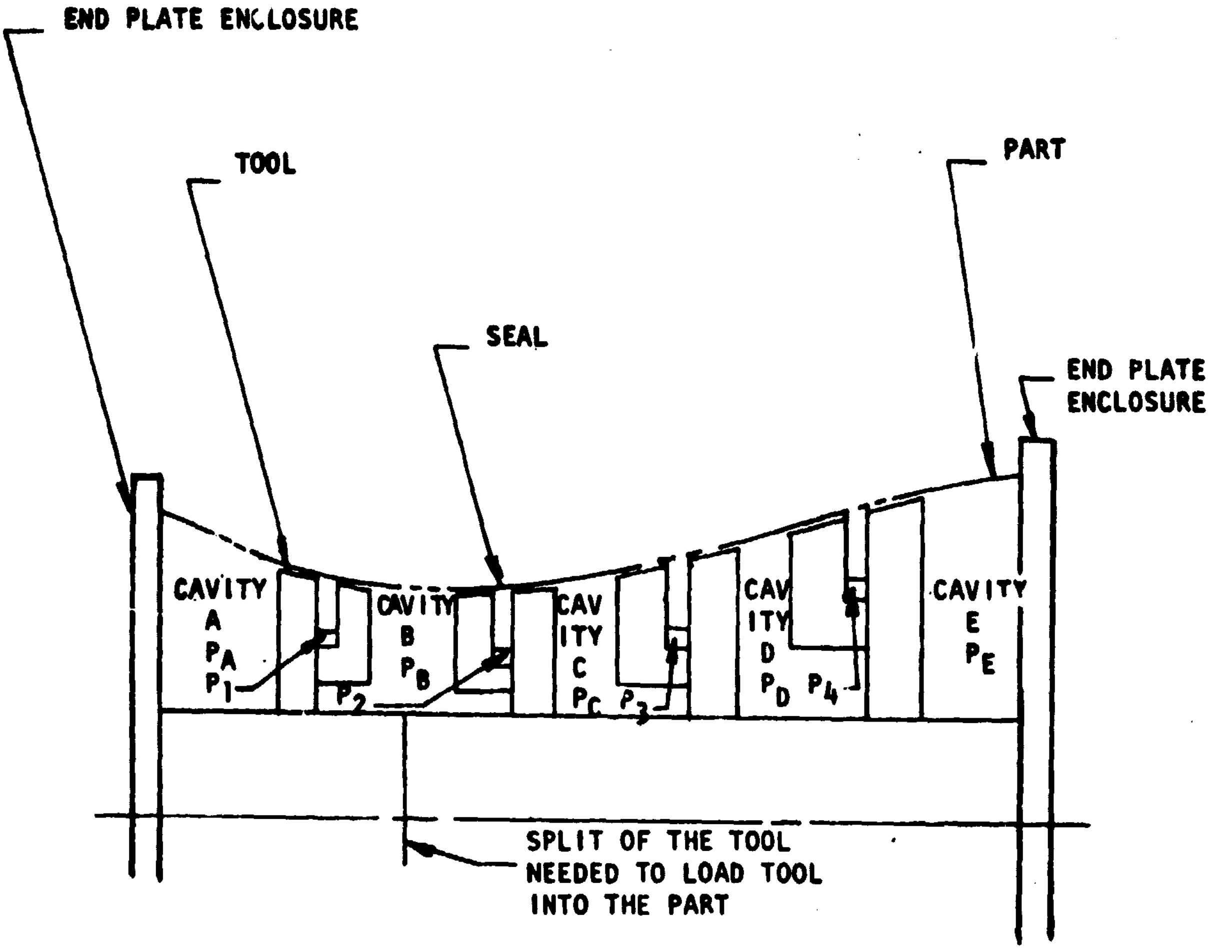

FIG. 6